



## Campaign to Prevent Antimicrobial Resistance

Centers for Disease Control and Prevention  
National Center for Infectious Diseases  
Division of Healthcare Quality Promotion

*Clinicians hold the solution!*

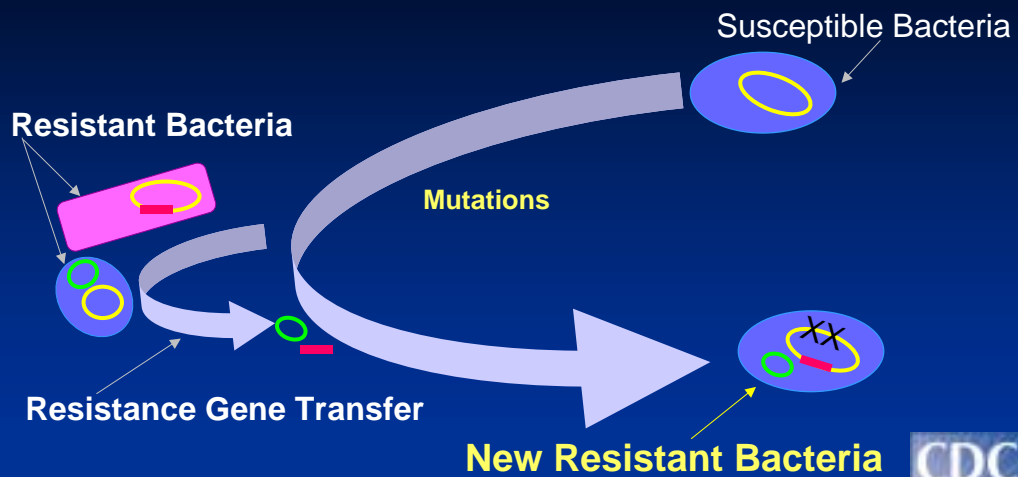


- Link to: [Campaign to Prevent Antimicrobial Resistance Online](#)
- Link to: [Federal Action Plan to Combat Antimicrobial Resistance](#)

- The Centers for Disease Control and Prevention (CDC), the National Institutes of Health (NIH), and the Food and Drug Administration (FDA) led a task force of 10 agencies to develop a comprehensive plan to address the emerging threat of antimicrobial resistance.
- One of the top priority items in the plan is “ In collaboration with many partners, develop and facilitate the implementation of educational and behavioral interventions that will assist clinicians in appropriate antimicrobial prescribing.”
- In conjunction with the CDC Foundation, corporate partners, professional societies, healthcare organizations, public health agencies, and expert consultants, **CDC’s Campaign to Prevent Antimicrobial Resistance** is a nationwide effort to address this priority.



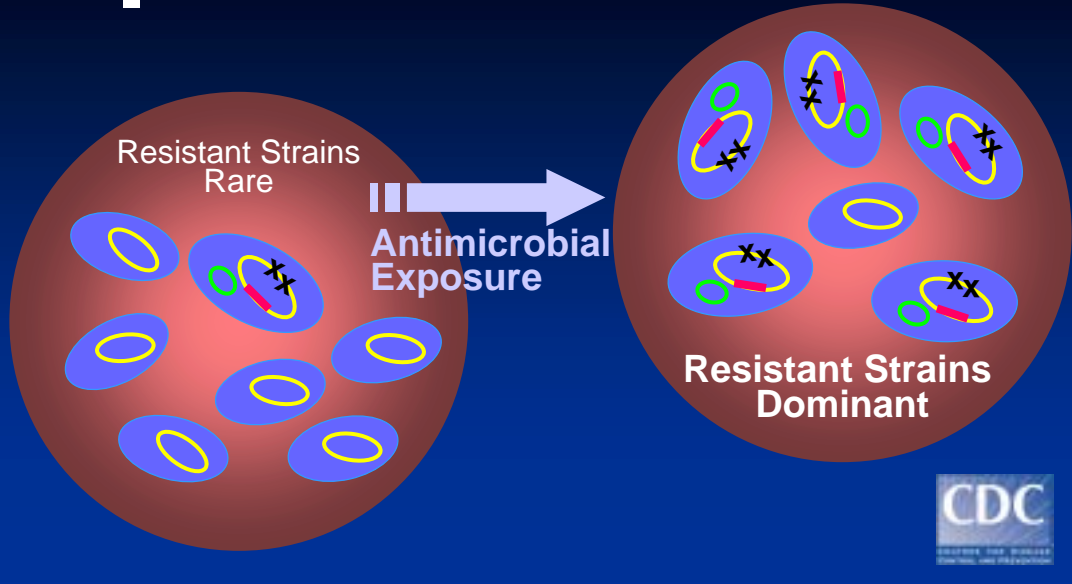
## Emergence of Antimicrobial Resistance



- Bacteria have evolved numerous mechanisms to evade antimicrobial drugs.
- Chromosomal mutations are an important source of resistance to some antimicrobials.
- Acquisition of resistance genes or gene clusters, via conjugation, transposition, or transformation, accounts for most antimicrobial resistance among bacterial pathogens.
- These mechanisms also enhance the possibility of multi-drug resistance.



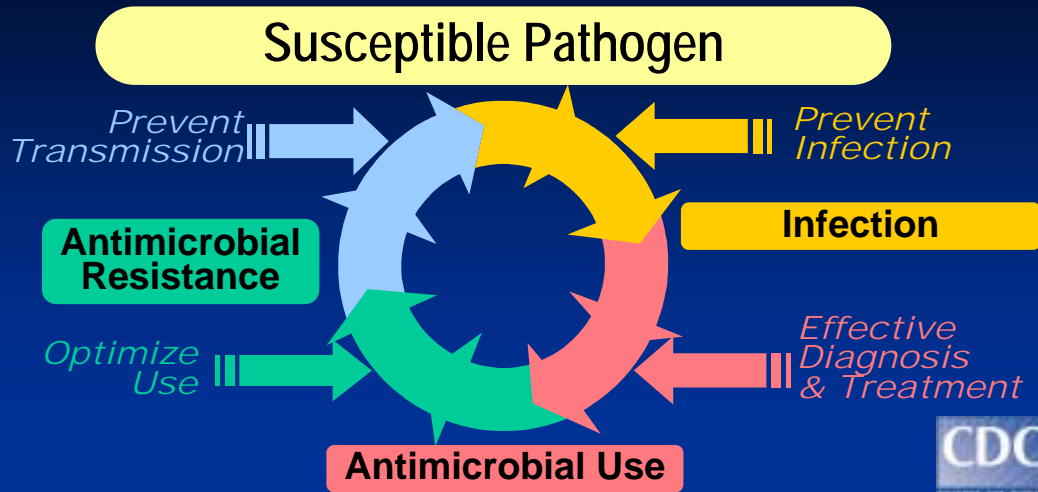
## Selection for antimicrobial-resistant Strains



- Once resistant strains of bacteria are present in a population, exposure to antimicrobial drugs favors their survival.
- Reducing antimicrobial selection pressure is one key to preventing antimicrobial resistance and preserving the utility of available drugs for as long as possible.



## Antimicrobial Resistance: Key Prevention Strategies



- Once a pathogen produces infection, antimicrobial treatment may be essential.
- However, antimicrobial use promotes selection of antimicrobial-resistant strains of pathogens.
- As the prevalence of resistant strains increases in a population, subsequent infections are increasingly likely to be caused by these resistant strains.
- Fortunately, this cycle of emerging antimicrobial resistance / multi-drug resistance can be interrupted.
- **Preventing infections** in the first place will certainly reduce the need for antimicrobial exposure and the emergence and selection of resistant strains.
- **Effective diagnosis and treatment** will benefit the patient and decrease the opportunity for development and selection of resistant microbes; this requires rapid accurate diagnosis, identification of the causative pathogen, and determination of its antimicrobial susceptibility.
- **Optimizing antimicrobial use** is another key strategy; optimal use will ensure proper patient care and at the same time avoid overuse of broad-spectrum antimicrobials and unnecessary treatment.
- Finally, **preventing transmission** of resistant organisms from one person to another is critical to successful prevention efforts.



## Key Prevention Strategies



- **Prevent infection**
- **Diagnose and treat infection effectively**
- **Use antimicrobials wisely**
- **Prevent transmission**

*Clinicians hold the solution!*



• These 4 strategies – **preventing infection, diagnosing and treating infection effectively, using antimicrobials wisely, and preventing transmission** - form the framework for CDC's Campaign to Prevent Antimicrobial Resistance.

• Clinicians and their patient care partners hold the solution to integrating these strategies into daily practice and optimizing the care and safety of all patients.



## Campaign to Prevent Antimicrobial Resistance in Healthcare Settings

- General health communication strategy
- Goals:
  - inform clinicians, patients, and other stakeholders
  - raise awareness about the escalating problem of antimicrobial resistance in healthcare settings
  - motivate interest and acceptance of interventional programs to prevent resistance



- The Campaign to Prevent Antimicrobial Resistance is one of CDC's health communications priorities.
- The Campaign targets frontline clinicians, patient care partners, healthcare organizations, purchasers, patients, and the general public.
- The goals are to raise awareness about the importance of escalating antimicrobial resistance and motivate involvement in targeted interventional programs, such as the **“12 Steps to Prevent Antimicrobial Resistance”**.



## 12 Steps To Prevent Antimicrobial Resistance

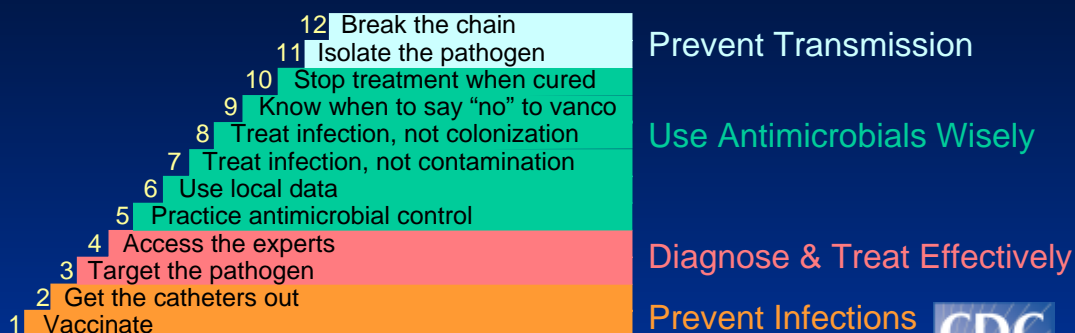
- Targeted intervention programs for clinicians caring for high risk patients
  - *hospitalized adults*      - *dialysis patients*      - *surgical patients*
  - *hospitalized children*      - *long-term care patients*
- Goal: Improve clinician practices & prevent antimicrobial resistance
- Partnership with professional societies; evidence base published in peer-reviewed specialty journals
- Educational tools – web-based / didactic learning modules, pocket cards, slide presentations, etc.



- The “12 Steps to Prevent Antimicrobial Resistance” are new programs that encourage clinicians to engage in actions that will promote patient safety and prevent antimicrobial-resistant infections.
- The evidence-based action steps are designed to optimize the care of individual patients in the era of widespread antimicrobial resistance.
- Each “12 Steps to Prevent Antimicrobial Resistance” program addresses a specific target patient population, such as hospitalized adults and children, geriatric patients, dialysis patients, surgical patients, etc.
- The goals of these intervention programs are to improve clinician practices and prevent antimicrobial resistance.
- The programs are created in close partnership with professional societies and key opinion leaders in the relevant specialty.
- All action steps included in the programs are based on scientific evidence and/or published guidelines.
- The program translates this existing evidence and guidance into **ACTION STEPS** that can be taken now to prevent antimicrobial resistance.
- CDC is working with many public, professional, and private sector partners to market the 12 Steps for each target group and promote their implementation.



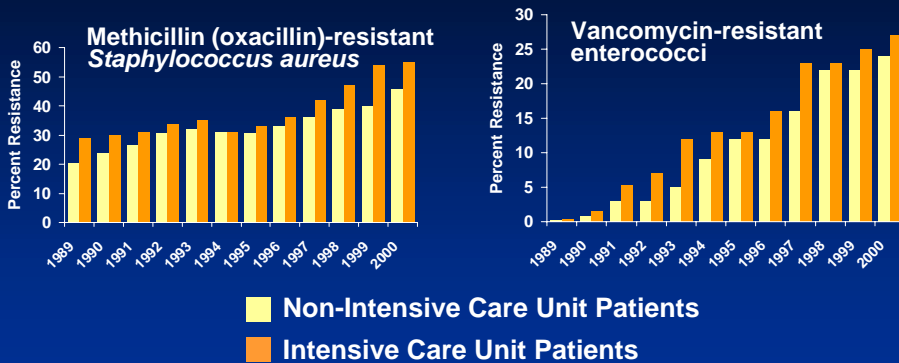
# 12 Steps to Prevent Antimicrobial Resistance: Hospitalized Adults



- The “12 Steps to Prevent Antimicrobial Resistance: Hospitalized Adults” intervention program is the first “12 Steps” to be launched because hospital patients are at especially high risk for serious antimicrobial-resistant infections.
- Each year nearly 2 million patients in the United States get an infection in a hospital.
- Of those patients, about 90,000 die as a result of their infection.
- More than 70% of the bacteria that cause hospital-acquired infections are resistant to at least one of the drugs most commonly used to treat them.
- Persons infected with antimicrobial-resistant organisms are more likely to have longer hospital stays and require treatment with second-or third-choice drugs that may be less effective, more toxic, and/or more expensive.



## Antimicrobial Resistance among Pathogens Causing Hospital-Onset Infections



Source: National Nosocomial Infections Surveillance (NNIS) System

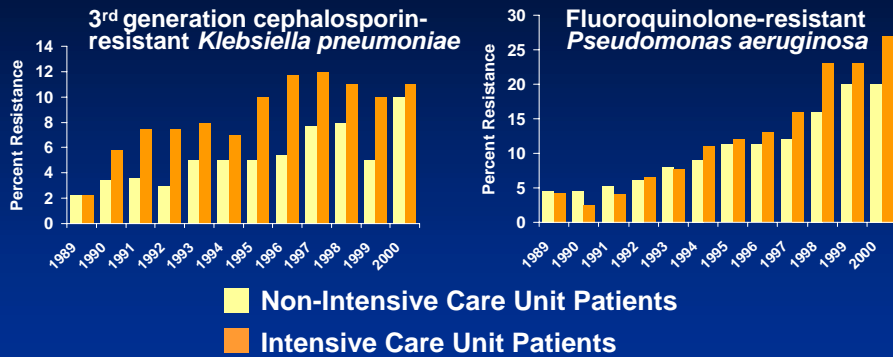


➤ [Link to: NNIS Online at CDC](#)

- The proportion of pathogens causing hospital-onset infections that are resistant to target antimicrobial drugs continues to increase at an alarming rate.
- Currently, more than 50% of *Staphylococcus aureus* isolates causing infections in intensive care units are resistant to methicillin; more than 40% are resistant in other hospital units.
- Vancomycin-resistant enterococci (VRE) emerged in the late 1980s and are now endemic in many hospitals.
- In many hospitals, more than 25% of enterococcal infections are caused by vancomycin-resistant strains.



## Antimicrobial Resistance among Pathogens Causing Hospital-Onset Infections



Source: National Nosocomial Infections Surveillance (NNIS) System



➤ [Link to: NNIS Online at CDC](#)

- The problem of antimicrobial resistance also includes gram-negative organisms.
- Klebsiella* and many other Enterobacteriaceae have acquired extended-spectrum beta-lactamases (ESBL) that confer resistance to cephalosporins.
- Resistance to fluoroquinolones is also emerging, an observation attributable to the expanding use of this class of antimicrobials in the past decade.



## Prevalence of Antimicrobial-Resistant (R) Pathogens Causing Hospital-Onset Intensive Care Unit Infections: 1999 versus 1994-98

Organism	# Isolates	% Increase*
Fluoroquinolone-R <i>Pseudomonas</i> spp.	2657	49%
3 <sup>rd</sup> generation cephalosporin-R <i>E. coli</i>	1551	48%
Methicillin-R <i>Staphylococcus aureus</i>	2546	40%
Vancomycin-R enterococci	4744	40%
Imipenem-R <i>Pseudomonas</i> spp.	1839	20%

\* Percent increase in proportion of pathogens resistant to indicated antimicrobial

Source: National Nosocomial Infections Surveillance (NNIS) System



➤ [Link to: NNIS Online at CDC](#)

- The rate of increased prevalence of resistance for some organisms is alarming.
- For example, the prevalence of fluoroquinolone resistance among *Pseudomonas* increased by almost 50% in 5 years.
- Likewise, ESBL-producing gram-negative pathogens, MRSA, and VRE continue to account for an increasing proportion of hospital-onset infections.
- Imipenem resistance is still not common, but has emerged in some locales.



## 12 Steps to Prevent Antimicrobial Resistance: Hospitalized Adults

### Prevent Infection

1. Vaccinate
2. Get the catheters out

### Diagnose and Treat Infection Effectively

3. Target the pathogen
4. Access the experts

### Use Antimicrobials Wisely

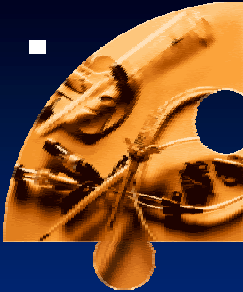
5. Practice antimicrobial control
6. Use local data
7. Treat infection, not contamination
8. Treat infection, not colonization
9. Know when to say “no” to vanco
10. Stop treatment when infection is cured or unlikely

### Prevent Transmission

11. Isolate the pathogen
12. Break the chain of contagion



- These 12 steps to Prevent Antimicrobial Resistance among hospitalized adults are **action steps** that clinicians can and should take now.
- They are designed to optimize patient safety and the outcome of infectious disease management.
- Together, these steps can prevent the emergence and spread of antimicrobial-resistant pathogens.



## **Prevent Infection** **Step 1: Vaccinate**

### **Fact:**

Pre-discharge influenza and pneumococcal vaccination of at-risk **hospital patients** AND influenza vaccination of **healthcare personnel** will prevent infections.

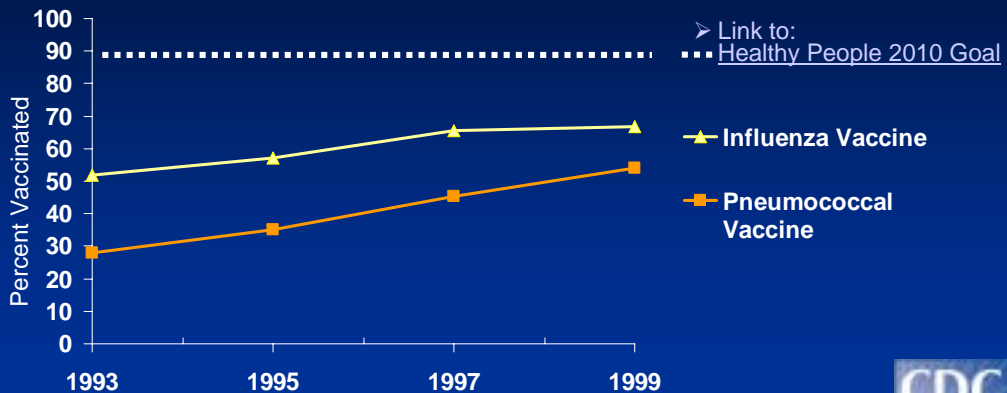


- On average, influenza causes approximately 114,000 influenza-related hospitalizations and 20,000 deaths in the United States.
- *Streptococcus pneumoniae* is associated with 12,500 deaths, at least 50% of which are likely to be preventable with vaccination.
- These vaccine-preventable infections and their complications are a major cause of hospitalization and exposure to antimicrobials, and create opportunities for emergence and spread of antimicrobial resistance.



## Need for Hospital-Based Vaccination: U.S. Persons Aged 65 or Older Who Report Vaccination

(Behavioral Risk Factor Surveillance System, United States 1993 – 1999)



➤ Link to: [U.S. Vaccination Rates...MMWR 2001; 50:532-7](#)



- Vaccination of target populations is a high priority for public health agencies, as articulated in *Healthy People 2010*.
- Nevertheless, national rates of vaccination remain below targeted levels, and additional methods to improve vaccine coverage are needed.
- In 1999, less than 70% of persons who were recommended to receive influenza vaccine reported vaccination.
- Less than 50% of those for whom pneumococcal vaccine is recommended reported vaccination.
- Likewise, influenza vaccination of healthcare providers is recommended but coverage rates are notoriously poor.



## Need for Hospital-Based Vaccination: Post-discharge Vaccination Status of Hospitalized Adults

Population	Influenza Vaccine	Pneumococcal Vaccine
Age 18-64 years with medical risk*	17% vaccinated	31% vaccinated
Age > 65 years*	45% vaccinated	68% vaccinated
Hospitalized for pneumonia during influenza season**	35% vaccinated	20% vaccinated

- Link to: [CDC, National Health Interview Survey, 1997](#)
- Link to: [Medicare beneficiaries in 12 western states, 1994](#)



- Hospitalization represents a “missed opportunity” for vaccination.
- Discharged patients are unlikely to have received pneumococcal vaccine even when they are at high risk.
- Older hospital patients are more likely to have received influenza vaccine than younger patients, but a significant proportion in both groups was not vaccinated in either group.



## Need for Healthcare Personnel Immunization Programs: Influenza Vaccination Rates (1996-97)

	% Vaccinated
All adults $\geq$ 65 yrs. of age	63%
Healthcare personnel at high risk*	38%
All healthcare personnel**	34%

Source: 1997 National Health Interview Survey  
Walker FJ, et. al: *Infect Control Hosp Epidemiol* 2000; 21:113



➤ Link to: [ACIP Influenza Immunization Recommendations](#)

- Outbreaks of influenza in hospitals have been linked to transmission from otherwise healthy healthcare personnel and are a major patient safety issue.
- The Advisory Committee on Immunization Practices (ACIP) recommends that healthcare personnel with patient care duties receive an annual influenza vaccine.
- However, vaccination rates among healthcare personnel are extremely poor; less than 40% of personnel are immunized in most facilities.

\* One or more high-risk medical conditions including diabetes, current cancer treatment, or chronic heart, lung, or kidney disease.

\*\* Healthcare workers included persons currently employed in healthcare occupations, regardless of setting, and persons currently employed in healthcare settings without a healthcare occupation.



## Prevent Infection

### Step 1: Vaccinate

**Fact:** Pre-discharge influenza and pneumococcal vaccination of at-risk hospital patients and influenza vaccination of healthcare personnel will prevent infections.

#### **Actions:**

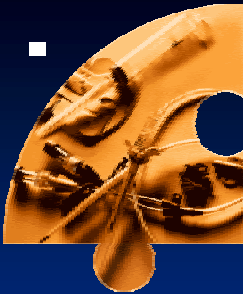
- ✓ give influenza / pneumococcal vaccine to at-risk patients before discharge
- ✓ get influenza vaccine annually

- [\*Link to: ACIP Influenza immunization recommendations\*](#)
- [\*Link to: CDC facts about influenza and pneumococcal vaccine\*](#)
- [\*Link to: ACIP: Vaccine standing orders\*](#)



•The Advisory Committee on Immunization Practices (ACIP) recommends standing orders for influenza and pneumococcal vaccinations to improve vaccination of hospitalized patients before discharge.

•In addition, ACIP and the Healthcare Infection Control Practices Advisory Committee (HICPAC) recommend that healthcare personnel should receive an annual influenza vaccine to protect patients and other healthcare personnel.



## **Prevent Infection** **Step 2:** **Get the catheters out**

### **Fact:**

Catheters and other invasive devices are the # 1 exogenous cause of hospital-onset infections.

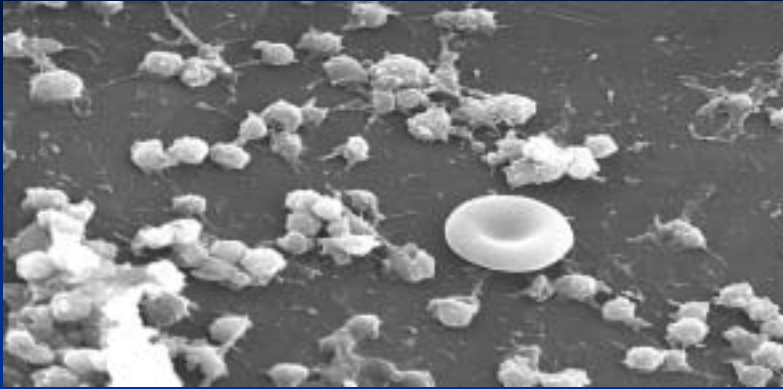


➤ [Link to: NNIS Online at CDC](#)

- Invasive medical devices are a major cause of preventable infections in hospitals.
- Intravenous catheters, arterial catheters, urinary tract catheters, endotracheal tubes, and many other devices increase the risk of hospital-onset infection in all patient populations.
- Based on the estimated number of central venous catheters used each day and typical infection rates, approximately 80,000 catheter-associated bloodstream infections occur in ICUs each year in the United States; the total number of these infections in all areas of the hospital is estimated to total 250,000 each year. (Kluger DM, Maki DG. The relative risk of intravascular device related bloodstream infections in adults. Abstracts of the 39th Interscience Conference on Antimicrobial Agents and Chemotherapy 1999:514).
- The estimated attributable mortality for catheter-associated bloodstream infections ranges from 0% to 35%, depending on study design.
- The estimated attributable cost per bloodstream infections ranges from \$34,508 to \$56,000, and the annual cost of caring for infected patients between \$296 million and \$2.3 billion.
- Data support patient safety impact and costs associated with indwelling urinary tract catheters.



## Biofilm on Intravenous Catheter Connector 24 hours after Insertion



Scanning Electron Micrograph



➤ [Link to: \*Biofilms and device-associated infections\*](#)

- All invasive medical devices support the development of biofilms.
- Biofilm is a complex three-dimensional structure that consists of cells, bacteria, and extracellular matrix materials.
- In this scanning electron micrograph, many bacteria are seen in a matrix of material that also contains a red blood cell.
- This biofilm developed within 24 hours of catheter insertion.
- Biofilms may promote development of antimicrobial-resistant infections in several ways:
  - Serving as a nidus for deposition and growth of resistant strains that then are released to cause infection;
  - Creating a permeability barrier to antimicrobial diffusion, so that bacteria imbedded in the biofilm may be exposed to sub-inhibitory concentrations of drug that promotes emergence of resistance;
  - Providing a matrix in which bacteria can exchange resistance factors.
- Biofilms cannot be prevented but some strategies may decrease the rate at which biofilms are formed and decrease bacterial colonization of biofilms.



## Prevent Infection

### Step 2: Get the catheters out

**Fact:** Catheters and other invasive devices are the # 1 exogenous cause of hospital-onset infections.

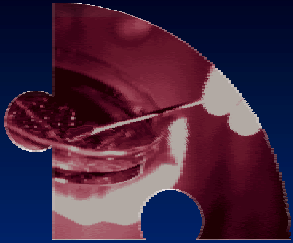
#### Actions:

- ✓ use catheters only when essential
- ✓ use the correct catheter
- ✓ use proper insertion & catheter-care protocols
- ✓ remove catheters when not essential

➤ Link to: [Urinary catheter infection prevention](#)  
*Coming soon...guidelines for preventing catheter-associated bloodstream infections*



- The most effective way to decrease device-associated infections is to decrease device utilization.
- In other words, **get the catheters out!**
- Catheters should only be used when essential to patient care, not for convenience or as a “routine” practice.
- In some cases, antimicrobial-impregnated catheters may be warranted to prevent infections.
- Proper insertion and catheter care may decrease contamination and infection risk.
- The need for a catheter should be assessed on a daily basis so that unnecessary catheters will be recognized and removed.



## *Diagnose & Treat Infection Effectively*

### **Step 3: Target the pathogen**

#### **Fact:**

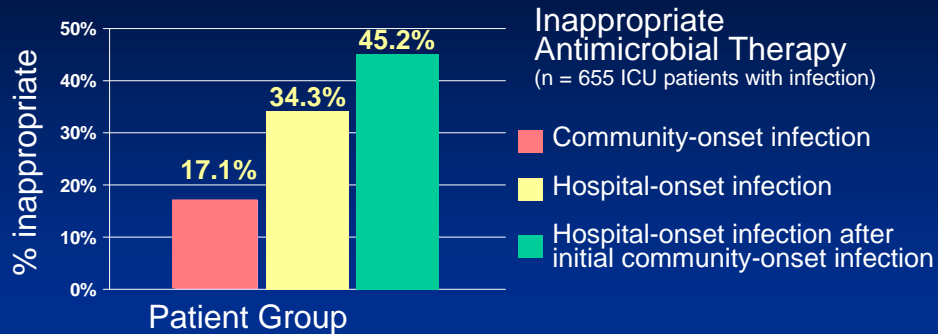
Appropriate antimicrobial therapy (correct regimen, timing, dosage, route, and duration) saves lives.



- Antimicrobial therapy can be life saving and represents one of the greatest medical achievements in the past century.
- It is essential that efforts to prevent antimicrobial resistance do not compromise the effective treatment of infections in individual patients.
- For individual patients, appropriate antimicrobial therapy includes choosing the correct antimicrobial drug or combination, proper timing, dosage, and route of administration, and proper treatment duration.



## Inappropriate Antimicrobial Therapy: Prevalence among Intensive Care Patients



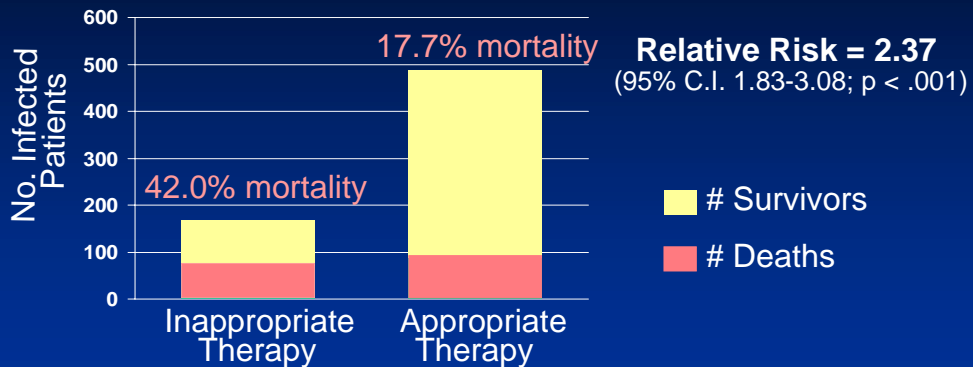
Source: Kollef M, et al: *Chest* 1999;115:462-74



- Unfortunately, not all patients receive appropriate antimicrobial treatment.
- In this prospective study of 2000 patients admitted to an intensive care unit, 655 patients had one or more infections.
- Treatment of 17.1% of those with community-onset infection was inappropriate; 34.3% of those with hospital-onset infection was inappropriate, and 45.2% of those with a hospital-onset infection complicating a community-onset infection was inappropriate.



## Inappropriate Antimicrobial Therapy: Impact on Mortality



Source: Kollef M, et al: Chest 1999;115:462-74



- This study demonstrates the strong association of inappropriate therapy and mortality.
- 42% of those who received inappropriate antimicrobial therapy died, compared to 17.7% of those who received appropriate therapy.
- In other words, the relative risk of mortality among those who received inappropriate therapy was 2.37.
- The difference in mortality rate was statistically significant even after adjustment for potential confounding by other factors.



## Susceptibility Testing Proficiency: 48 Clinical Microbiology Laboratories

<u>Test Organism</u>	<u>Accuracy</u>
Methicillin-resistant <i>S. aureus</i>	100%
Vancomycin-resistant <i>E. faecium</i>	100%
Fluoroquinolone-resistant <i>P. aeruginosa</i>	100%
Erythromycin-resistant <i>S. pneumoniae</i>	97%
Carbapenem-resistant <i>S. marcescens</i>	75%
Extended spectrum $\beta$ -lactamase <i>K. pneumoniae</i>	42%

Source: Steward CD, et al: *Diagn Microbiol Infect Dis.* 2000;38:59-67



- Successful pathogen-directed therapy depends on microbiology laboratory proficiency.
- This sample of 48 microbiology laboratories that were affiliated with CDC's Project ICARE (Intensive Care Antimicrobial Resistance Epidemiology) had excellent proficiency in detecting antimicrobial-resistance among test strains.
- These laboratories did have some difficulty identifying carbapenem resistance in *Serratia marcescens* and cephalosporin resistance due to extended-spectrum beta-lactamase production in *Klebsiella pneumoniae*.



## CDC's *MASTER*: Improving Antimicrobial Susceptibility Testing Proficiency



➤ Link to: [MASTER Online at CDC](#)

- CDC has developed a new tool to assist laboratory personnel.
- “MASTER” provides case studies, updates about important methods, reviews of important publications, and many other resources to promote laboratory proficiency in assessing antimicrobial susceptibility.
- MASTER is accessible online through the CDC website.



## *Diagnose & Treat Infection Effectively* **Step 3: Target the pathogen**

**Fact:** Appropriate antimicrobial therapy saves lives.

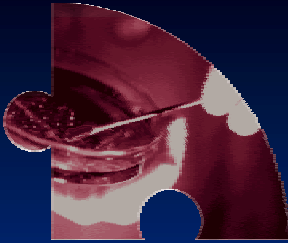
### **Actions:**

- ✓ culture the patient
- ✓ target **empiric therapy** to likely pathogens and local antibiogram
- ✓ target **definitive therapy** to known pathogens and antimicrobial susceptibility test results



➤ *Link to: [IDSA guidelines for evaluating fever in critically ill adults](#)*

- Correct diagnosis of the causative pathogen is necessary to ensure appropriate antimicrobial therapy.
- Hence, cultures are almost always indicated when managing hospitalized adults with known or suspected infection.
- Empiric antimicrobial therapy should be selected to target **likely pathogens** and be consistent with **local antimicrobial susceptibility data**.
- Definitive therapy should target **known pathogens** once they are identified and their **antimicrobial susceptibility test results** are known.



*Diagnose & Treat  
Infection Effectively*

**Step 4:  
Access the experts**

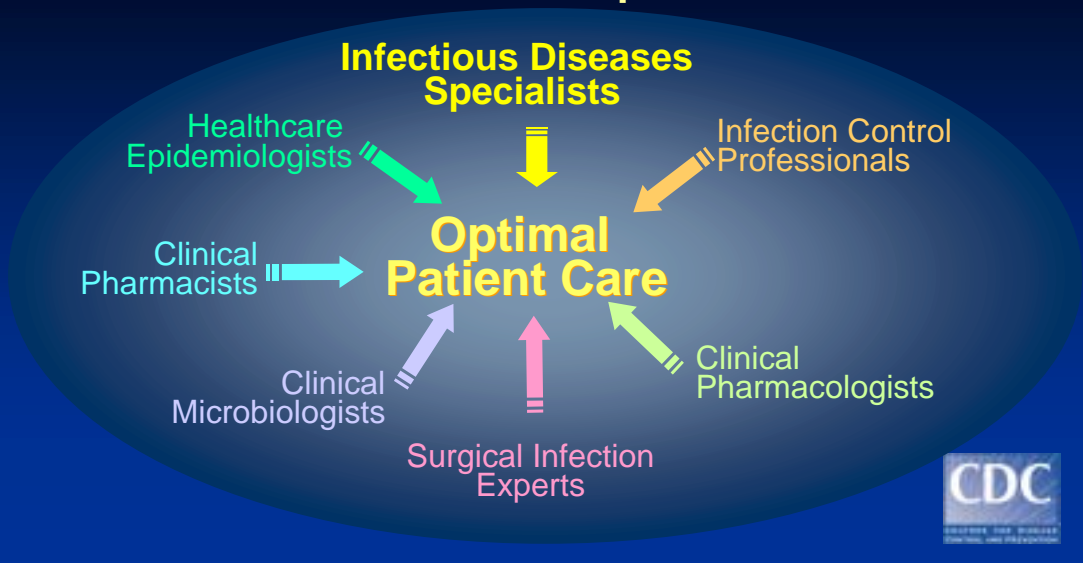
**Fact:** Infectious diseases expert input improves the outcome of serious infections.



- Several studies suggest that input from professionals with infectious diseases expertise can improve patient outcomes, improve antimicrobial use, decrease treatment costs, and decrease the length of hospital stay.



## ■ Infectious Diseases Expert Resources



- Infectious diseases specialists are one important resource for providing input, but many other professionals also contribute to optimal care for patients with infections.
- Like all patient safety endeavors, multidisciplinary collaboration is key!



## **Diagnose & Treat Infection Effectively**

### **Step 4: Access the experts**

**Fact:** Infectious diseases expert input improves the outcome of serious infections.

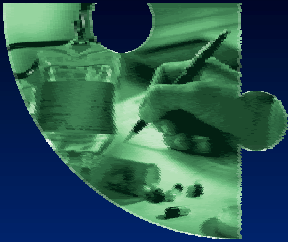
### **Action:**

- ✓ consult infectious diseases experts about patients with serious infections

➤ [Link to: SHEA / IDSA: Guidelines for the Prevention of Antimicrobial Resistance in Hospitals](#)



- There are no performance standards that define when input from professionals with infectious diseases expertise should be obtained.
- Consultation should be considered for patients with complicated underlying illnesses, those who are receiving complicated antimicrobial treatment regimens, those who fail to respond to therapy as expected, and those at increased risk for drug-drug interactions or other adverse events associated with treatment.
- Of course, early surgical consultation is essential when there is any suspicion of infection requiring surgical drainage or remediation.



## *Use Antimicrobials Wisely* **Step 5: Practice antimicrobial control**

**Fact:** Programs to improve antimicrobial use are effective.



- The importance of wise use of antimicrobials has been emphasized for many years.
- Many hospital-based programs to improve antimicrobial utilization have been implemented.



## Methods to Improve Antimicrobial Use

- Passive prescriber education
- Standardized antimicrobial order forms
- Formulary restrictions
- Prior approval to start/continue
- Pharmacy substitution or switch
- Multidisciplinary drug utilization evaluation (DUE)
- Interactive prescriber education
- Provider/unit performance feedback
- Computerized decision support/on-line ordering

➤ [Link to: SHEA / IDSA: Guidelines for the Prevention of Antimicrobial Resistance in Hospitals](#)



- Passive education of healthcare personnel is probably the least effective strategy for improving antimicrobial use, but does have some impact.
- Strategies designed to limit use, including antimicrobial order forms, formulary restrictions, and approval systems, can be successful, but only if resources are applied to ensure oversight and response.
- Automatic pharmacy substitution of one similar drug for another or from one route of administration to another (e.g. IV to oral) can be highly successful in reducing costs, but is not always acceptable to clinicians.
- Multidisciplinary drug utilization evaluation is an approach favored in institutions that have successfully engaged the appropriate professionals in the process, but does require up-front personnel resources to have maximum cost-effectiveness.
- Interactive provider education is also a successful approach that is gaining acceptance as experience evolves.
- Performance feedback can be a powerful tool for improving antimicrobial prescribing patterns. This method is more likely to be acceptable when utilization in a unit is compared over time or to a benchmark; provider-specific performance feedback can be successfully implemented if initial resistance is overcome.
- Computerized decision support is likely to be the best long-term approach for improving antimicrobial use.



## Computerized Antimicrobial Decision Support

- Local clinician-derived consensus guidelines embedded in computer-assisted decision support programs
- 62,759 patients receiving antimicrobials over 7 years

	1988	1994
Medicare case-mix index	1.7481	2.0520
Hospital mortality	3.65%	2.65%
Antimicrobial cost per treated patient	\$122.66	\$51.90
Properly timed preoperative antimicrobial	40%	99.1%

- Stable antimicrobial resistance
- Adverse drug events decreased by 30%

Source: Pestotnik SL, et al: *Ann Intern Med* 1996;124:884-90



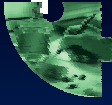
•In this study of patients admitted to a community hospital in Salt Lake City, Utah, computer-assisted decision support was successfully employed to guide antimicrobial treatment.

•Over a 7-year period of time after the system was implemented, the acuity of patients admitted to the hospital increased.

•However, hospital mortality, antimicrobial treatment costs per patient, and adverse drug events declined.

•The proportion of patients who received a properly-timed preoperative prophylactic antimicrobial increased dramatically.

•Overall, patterns of antimicrobial resistance were stable over the 7-year study period.



## Use Antimicrobials Wisely

### Step 5: Practice antimicrobial control

**Fact:** Programs to improve antimicrobial use are effective.

#### Action:

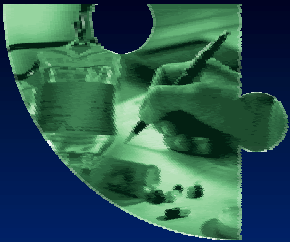
- ✓ engage in local antimicrobial use quality improvement efforts

Source: Schiff GD, et al: *Jt Comm J Qual Improv* 2001;27:387-402



➤ Link to: [\*Methods to improve antimicrobial use and prevent resistance\*](#)

- Whatever options are available for improving antimicrobial use, the commitment and participation of the prescribing clinician and the institution are essential.



## *Use Antimicrobials Wisely* **Step 6: Use local data**

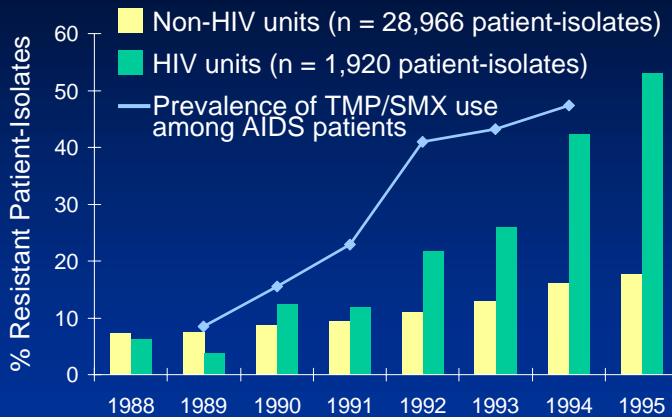
**Fact:** The prevalence of resistance can vary by time, locale, patient population, hospital unit, and length of stay.



- Antimicrobial susceptibility data are often aggregated into “antibiograms”, which provide a summary picture of common organisms and their susceptibility to many antimicrobial drugs.
- Antibiograms provide a starting point for making decisions about empiric antimicrobial treatment, but do not necessarily reliably predict susceptibility of pathogens from a given patient because the data are not stratified by relevant characteristics that may affect the prevalence of resistance.



## Trimethoprim/sulfamethoxazole (TMP/SMX) Resistance Among Bacterial Patient-Isolates\*



San Francisco General Hospital

Martin JN, et al: J Infect Dis 1999;180:1809-18

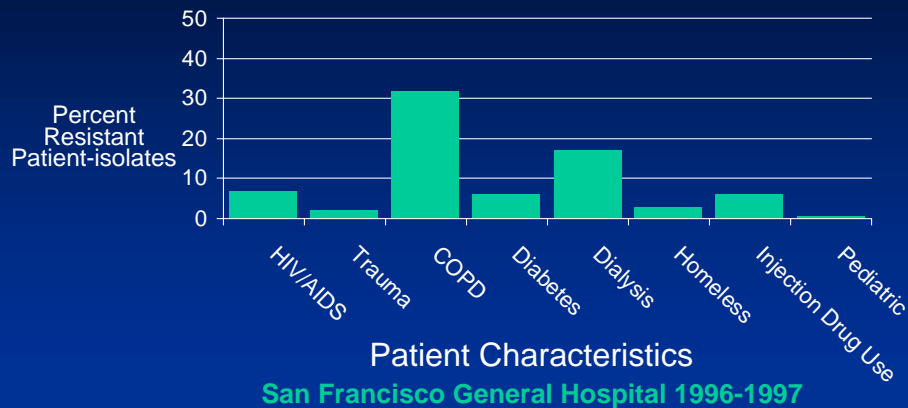
\* 30,886 patient-isolates  
*Staphylococcus aureus*  
*Escherichia coli*  
*Enterobacter spp.*  
*Klebsiella pneumoniae*  
*Morganella spp.*  
*Proteus spp.*  
*Serratia spp.*  
*Citrobacter spp.*



- In this example, the proportion of more than 30,000 bacterial patient-isolates evaluated at San Francisco General Hospital that were resistant to trimethoprim/sulfamethoxazole (TMP/SMX) steadily increased over an 8 year period.
- When the antibiogram was stratified by HIV versus non-HIV patient unit, major differences in the proportion of resistance were noted.
- This observation was attributed to the increasing use of TMP/SMX for prevention of opportunistic infections among HIV-infected patients during this same time interval.



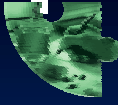
## Prevalence of Fluoroquinolone-Resistant *Escherichia coli*: Variability among Patient Populations



San Francisco General Hospital 1996-1997



- Many patient characteristics may affect the probability of resistance.
- For example, the proportion of *Escherichia coli* isolates resistant to fluoroquinolones detected among patients at San Francisco General Hospital ranged from 0% among pediatric patients to more than 30% among those who had chronic pulmonary disease.
- Many contemporary laboratory information systems can provide similar profiles of antimicrobial susceptibility data with stratification for a variety of patient, temporal, and facility characteristics.



## **Use Antimicrobials Wisely** **Step 6: Use local data**

**Fact:** The prevalence of resistance can vary by locale, patient population, hospital unit, and length of stay.

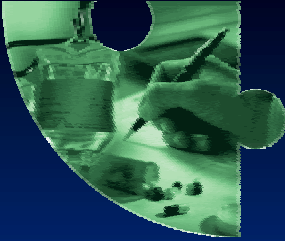
### **Actions:**

- ✓ know your local antibiogram
- ✓ know your patient population



➤ Link to: [\*NCCLS Proposed Guidance for Antibiogram Development\*](#)

- Local antimicrobial susceptibility data are the most relevant for predicting the probability of resistance.
- Stratification of antibiogram data by additional patient characteristics might be useful in improving empiric treatment selections, but data are not yet available to confirm this.
- The National Center for Clinical Laboratory Standards (NCCLS) has developed new proposed guidance for clinical microbiology laboratories to improve the standardization of antibiogram preparation and reporting.
- The guidance includes definitions of “patient-isolate” and other information useful in interpreting antibiogram reports from different laboratories.



*Use Antimicrobials Wisely*  
**Step 7: Treat infection,  
not contamination**

**Fact:** A major cause of antimicrobial overuse is “treatment” of contaminated cultures.



- Contamination of blood culture specimens and other patient specimens often leads to unnecessary antimicrobial use.



## Blood Culture Contamination Benchmarks (649 institutions; 570,108 blood cultures)

	Contamination Rate* (percentile)		
	10th	50th	90th
Hospitalized adults	5.4	2.5	.9
Hospitalized children	7.3	2.3	.7
Neonates	6.5	2.1	0.0

\* percent of cultures contaminated

Source: Schiffman RB et al: Q-Probes Study 93-08. College Am Path; 1993.



➤ Link to: [College of American Pathologist contaminated blood culture survey](#)

- Contaminated blood cultures are common among hospitalized adults and other patient populations.
- In this survey conducted by the College of American Pathology, more than 570,000 blood cultures were evaluated to assess the frequency of contamination to establish benchmarks for quality improvement efforts.
- Use of tincture of iodine for skin decontamination and disinfection of the specimen container were factors associated with lower contamination rates.
- Zero contamination rate should be the goal; rates over 2% should raise serious concerns about processes of care, especially if vancomycin utilization rates also are high.



## Positive Blood Cultures Obtained through Central Venous Catheters Do Not Reliably Predict True Bacteremia\*

	Catheter Sample	Peripheral Vein Sample
Predictive Value Positive	63%	73%
Predictive Value Negative	99%	98%

\* 55 paired cultures from hospitalized hematology/oncology patients

Source: DesJardin JA, et al: *Ann Intern Med* 1999;131:641-7

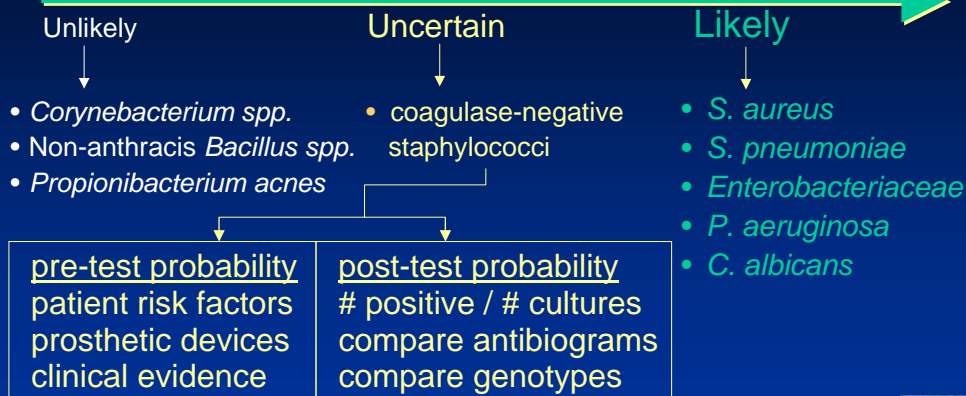


- Culture of blood drawn through an indwelling central venous catheter has low positive predictive value.
- In hospitalized hematology-oncology patients, culture of blood drawn through either the central catheter or peripheral vein showed excellent negative predictive value.
- Therefore, a positive culture result from a specimen obtained via a catheter needs clinical interpretation and usually requires additional laboratory confirmation.
- Use of a catheter to obtain blood for culture may be an acceptable method for excluding bloodstream infections.



## Interpreting a “Positive” Blood Culture

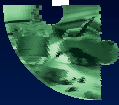
### True Bacteremia:



Source: Kim SD, et al: Infect Control Hosp Epidemiol 2000;21:213-7



- The presence of some organisms, such as *Propionibacterium acnes*, in blood culture is unlikely to indicate true bacteremia, unless the patient is at special risk.
- The presence of some organisms, such as *Staphylococcus aureus*, should be assumed to indicate true bacteremia unless proven otherwise.
- Identification of coagulase-negative staphylococci in blood is one of the major reasons for vancomycin use in the United States, but most often these organisms are contaminants.
- The first step to interpret blood culture results when coagulase-negative staphylococci are identified is to assess the pre-test probability of true bacteremia. Some patients, including those with endovascular implants and other prosthetic devices, are at increased risk for coagulase-negative staphylococcal bacteremia.
- Likewise, neutropenic patients are at increased risk.
- Vascular catheters also increase the risk, but most coagulase-negative cultures in catheterized patients without other risk factors are contaminants.
- In patients who are critically ill, treatment is usually indicated until true bacteremia is excluded in the differential diagnosis.
- Additional information can help assess the post-test probability of true bacteremia. If more than one specimen is growing coagulase-negative staphylococci, then true bacteremia is more likely than when a single specimen is positive.
- If more than one culture is positive, comparing the antibiograms can help determine if they are similar (more likely to represent true bacteremia) or different (less likely).
- The best method for assessing true bacteremia is to compare genotypes of the suspect strains. This method is not widely available and results are usually not timely enough to guide therapy.



## Use Antimicrobials Wisely

### Step 7: Treat infection, not contamination

**Fact:** A major cause of antimicrobial overuse is “treatment” of contaminated cultures.

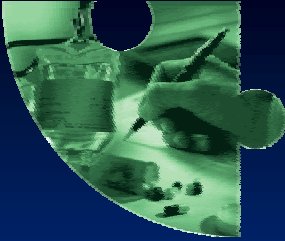
#### Actions:

- ✓ use proper antisepsis for blood & other cultures
- ✓ culture the blood, not the skin or catheter hub
- ✓ use proper methods to obtain & process all cultures



➤ [Link to: CAP standards for specimen collection and management](#)

- Optimizing skin antisepsis is the first critical step in obtaining blood samples for culture.
- Proper specimen collection and management is key to preventing contaminated cultures.



## *Use Antimicrobials Wisely* **Step 8: Treat infection, not colonization**

**Fact:** A major cause of antimicrobial overuse is “treatment” of colonization.



- Patients often become colonized with new bacterial flora while hospitalized.
- Since many of the colonizing bacteria arise from hospital flora, they are apt to be resistant to first-line antimicrobial drugs.
- When fever or other evidence of infection is mistakenly attributed to these colonizing organisms, unnecessary broad-spectrum antimicrobial therapy ensues.



## Invasive Bronchoscopic Diagnostic Tests Reduce Antimicrobial Use in Suspected Ventilator-Associated Pneumonia\*

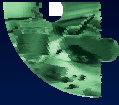
	Invasive Diagnosis	Non-invasive Diagnosis	
Antimicrobial-free days (at day 28)	11.0	7.5	$p < .001$
Mortality	16.2%	25.8%	$p = .022$

\*413 patients; 31 intensive care units

Source: Fagon JY, et al: *Ann Intern Med* 2000;132:621-30



- The invasive diagnostic approach to patients with suspected ventilator-associated pneumonia included direct examination and quantitative culture of bronchoscopic-protected specimen brush samples or bronchoalveolar lavage samples.
- The noninvasive strategy relied on clinical criteria, culture of endotracheal aspirates, and clinical guidelines.
- Patients who underwent invasive diagnostic evaluation had fewer days of antimicrobial exposure but no increase in mortality.
- In this study, invasive diagnostic evaluation improved the specificity of the pneumonia diagnosis in febrile patients.



## Use Antimicrobials Wisely

### Step 8: Treat infection, not colonization

**Fact:** A major cause of antimicrobial overuse is treatment of colonization.

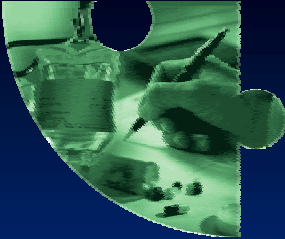
#### Actions:

- ✓ treat pneumonia, not the tracheal aspirate
- ✓ treat bacteremia, not the catheter tip or hub
- ✓ treat urinary tract infection, not the indwelling catheter



➤ Link to: [\*IDSA guideline for evaluating fever in critically ill adults\*](#)

- Clinical criteria and additional laboratory data can help distinguish infection from colonization.
- Improving the specificity of diagnostic criteria for infection can help reduce unnecessary antimicrobial use.



*Use Antimicrobials Wisely*  
**Step 9: Know when to  
say “no” to vanco**

**Fact:** Vancomycin overuse promotes emergence, selection, and spread of resistant pathogens.

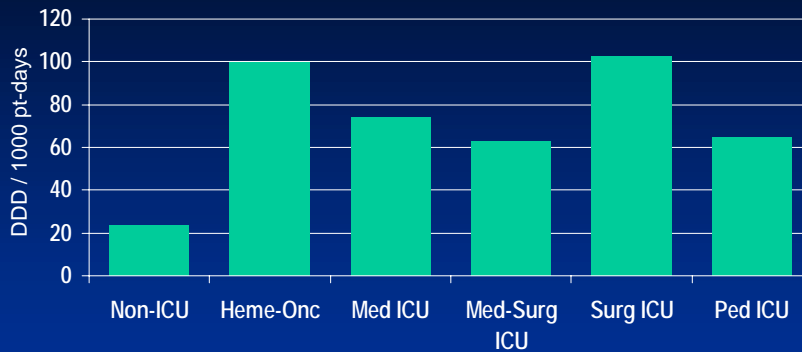


- Emergence of vancomycin resistance among gram-positive organisms is a major threat to patient safety in hospitals.
- Overuse of vancomycin promotes selection and spread of these resistant organisms.



## Vancomycin Utilization in Hospitals

(defined daily doses per 1000 patient-days)

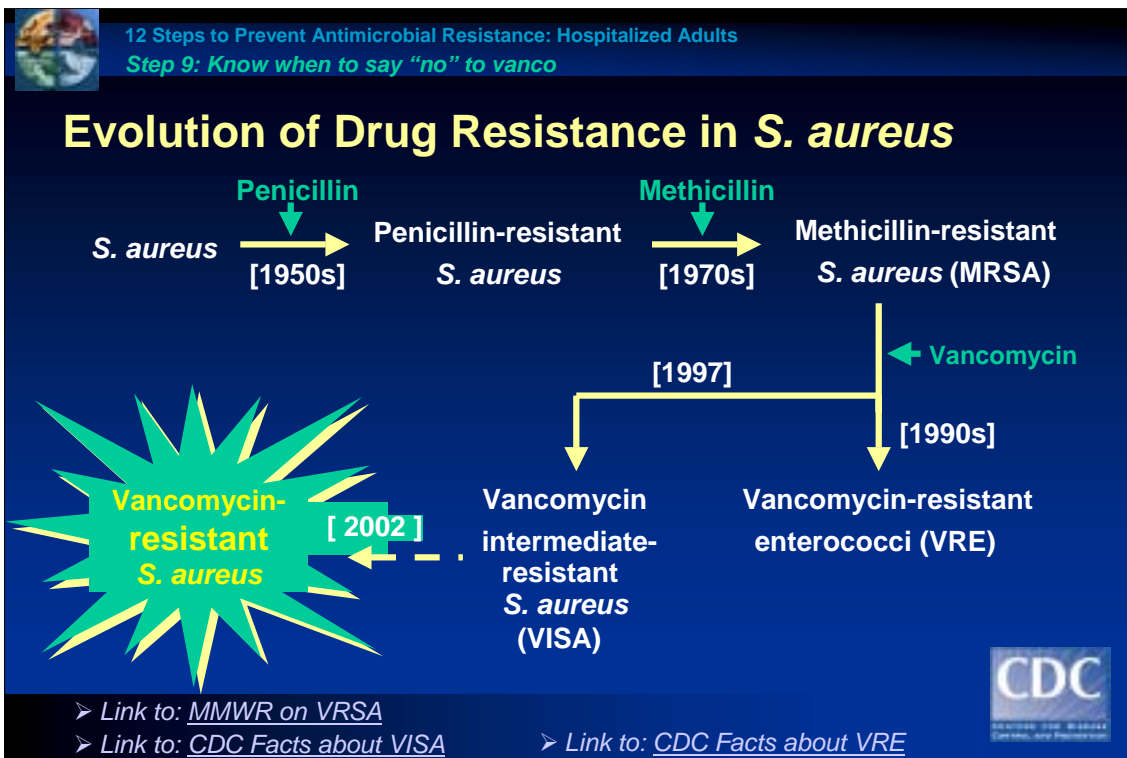


Source: National Nosocomial Infections Surveillance (NNIS) System

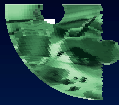


➤ [Link to: NNIS Online at CDC](#)

- Vancomycin utilization varies among patient populations.
- Nevertheless, exposure is common; in a subset of NNIS hospitals, patients were exposed to vancomycin during 2%-10% of all patient-days.
- This degree of exposure creates a powerful selection force and encourages emergence and spread of vancomycin-resistant bacteria.



- Introduction of every new class of antimicrobial drug is followed by emergence of resistance.
- By the 1950s, penicillin-resistant *S. aureus* were a major threat in hospitals and nurseries.
- By the 1970s, methicillin-resistant *S. aureus* had emerged and spread, a phenomenon that encouraged widespread use of vancomycin.
- In the 1990s, vancomycin-resistant enterococci emerged and rapidly spread; most of these organisms are resistant to other traditional first-line antimicrobial drugs.
- At the end of the century, the first *S. aureus* strains with reduced susceptibility to vancomycin were documented, prompting concerns that *S. aureus* fully resistant to vancomycin may be on the horizon.
- In June 2002 the first case of vancomycin-resistant *S. aureus* was detected.



## Use Antimicrobials Wisely

### Step 9: Know when to say “no” to vanco

**Fact:** Vancomycin overuse promotes emergence, selection, and spread of resistant pathogens.

#### Actions:

- ✓ treat infection, not contaminants or colonization
- ✓ fever in a patient with an intravenous catheter is not a routine indication for vancomycin



➤ Link to: [CDC guidelines to prevent vancomycin resistance](#)

•Although it may be too late to prevent the emergence of vancomycin resistance, avoidance of unnecessary use may reduce the speed at which resistant organisms emerge and spread in specific populations.

•Guidelines for appropriate vancomycin use have been developed by HICPAC/CDC:

Situations in which the use of vancomycin is appropriate or acceptable:

•For treatment of serious infections caused by beta-lactam-resistant gram-positive microorganisms. Vancomycin may be less rapidly bactericidal than are beta-lactam agents for beta-lactam-susceptible staphylococci.

•For treatment of infections caused by gram-positive microorganisms in patients who have serious allergies to beta-lactam antimicrobials.

•When antibiotic-associated colitis fails to respond to metronidazole therapy or is severe and potentially life-threatening.

•Prophylaxis, as recommended by the American Heart Association, for endocarditis following certain procedures in patients at high risk for endocarditis.

•Prophylaxis for major surgical procedures involving implantation of prosthetic materials or devices (e.g., cardiac and vascular procedures and total hip replacement) at institutions that have a high rate of infections caused by MRSA or methicillin-resistant *S. epidermidis*. A single dose of vancomycin administered immediately before surgery is sufficient unless the procedure lasts greater than 6 hours, in which case the dose should be repeated. Prophylaxis should be discontinued after a maximum of two doses.

Situations in which the use of vancomycin should be discouraged:

•Routine surgical prophylaxis other than in a patient who has a life-threatening allergy to beta-lactam antibiotics.

•Empiric antimicrobial therapy for a febrile neutropenic patient, unless initial evidence indicates that the patient has an infection caused by gram-positive microorganisms (e.g., at an inflamed exit site of Hickman catheter) and the prevalence of infections caused by MRSA in the hospital is substantial.

•Treatment in response to a single blood culture positive for coagulase-negative staphylococcus, if other blood cultures taken during the same time frame are negative (i.e., if contamination of the blood culture is likely). Because contamination of blood cultures with skin flora (e.g., *S. epidermidis*) could result in inappropriate administration of vancomycin, phlebotomists and other personnel who obtain blood cultures should be trained to minimize microbial contamination of specimens.

•Continued empiric use for presumed infections in patients whose cultures are negative for beta-lactam-resistant gram-positive microorganisms.

•Systemic or local (e.g., antibiotic lock) prophylaxis for infection or colonization of indwelling central or peripheral intravascular catheters.

•Selective decontamination of the digestive tract.

•Eradication of MRSA colonization.

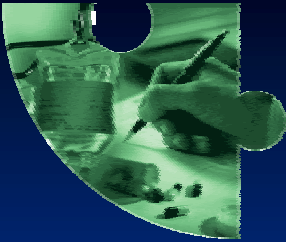
•Primary treatment of antibiotic-associated colitis.

•Routine prophylaxis for very low-birthweight infants (i.e., infants who weigh less than 1,500 g {3 lbs 4 oz}).

•Routine prophylaxis for patients on continuous ambulatory peritoneal dialysis or hemodialysis.

•Treatment (chosen for dosing convenience) of infections caused by beta-lactam-sensitive gram-positive microorganisms in patients who have renal failure.

•Use of vancomycin solution for topical application or irrigation.



## *Use Antimicrobials Wisely*

### **Step 10: Stop treatment when infection is cured or unlikely**

**Fact:** Failure to stop unnecessary antimicrobial treatment contributes to overuse and resistance.



- Once antimicrobial therapy is started, it is often difficult to stop, even when there is no indication for ongoing treatment.
- However, in some cases, unnecessary antimicrobial treatment may actually harm patients and add to treatment costs.



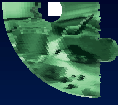
## Short-course Antimicrobial Treatment of New Pulmonary Infiltrates in an ICU

Variable	Standard Therapy (n=42)	Experimental Therapy (n = 39)
Regimen	clinician discretion (all treated; 18 drugs)	ciprofloxacin 400mg (IV bid x 3 days)
Treatment > 3 days	97%	28%
Antimicrobial resistance	35%	15%
Length of stay mean/median	14.7 / 9 days	9.4 / 4 days
Mortality (30 day)	31%	13%
Antimicrobial cost mean / total	\$640 / \$16,004	\$259 / \$6484



➤ Link to: [Singh N, et al. Am J Respir Crit Care Med 2000;162:505-11](#)

- This randomized unblinded clinical trial of patients in a Veteran's Administration Medical Center was designed to assess a pragmatic approach to use of antimicrobials in the ICU.
- Eligible patients had new-onset pulmonary infiltrate and a low clinical pulmonary infection score (CPIS  $\leq 6$ ), indicating that pneumonia was unlikely
- Clinicians selected treatment for those in the standard group; 18 different antimicrobials were prescribed alone or in combination to those in this group.
- Patients in the experimental group were treated with ciprofloxacin monotherapy for 3 days; after 3 days, treatment was stopped unless the CPIS  $> 6$  or infection at another site was documented.
- Patients in the experimental group had less antimicrobial exposure and less emergence of antimicrobial resistance / superinfection. Their length of stay was shorter and their antimicrobial treatment cost was lower.
- The difference in 30-day mortality rates for the 2 groups was not statistically significant.
- Over time, the participating clinicians began to choose ciprofloxacin monotherapy for patients in the standard therapy arm and the study was stopped.



## *Use Antimicrobials Wisely*

### **Step 10: Stop antimicrobial treatment**

**Fact:** Failure to stop unnecessary antimicrobial treatment contributes to overuse and resistance.

#### **Actions:**

- ✓ when infection is cured
- ✓ when cultures are negative and infection is unlikely
- ✓ when infection is not diagnosed



- Stopping treatment when infection is unlikely or not diagnosed does not lead to harm and in fact, might benefit patients.



## *Prevent Transmission* **Step 11:** **Isolate the pathogen**

**Fact:** Patient-to-patient spread of pathogens can be prevented.



- Isolation practices and other measures to prevent transmission of pathogens from one patient to another are effective but too often ignored components of antimicrobial resistance prevention.



*A Decade of Progress (1990-1999):*

## Hospital-Onset Infection Rates in NNIS Intensive Care Units

Type of ICU	BSI*	VAP*	UTI*
Coronary	43%	42%	40%
Medical	44%	56%	46%
Surgical	31%	38%	30%
Pediatric	32%	26%	59%

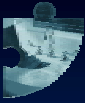
\* BSI = central line-associated bloodstream infection rate  
VAP = ventilator-associated pneumonia rate  
UTI = catheter-associated urinary tract infection rate

Source: National Nosocomial Infections Surveillance (NNIS) System



➤ Link to: [MMWR: Successful Healthcare Infection Prevention: Case History](#)

- Efforts to prevent infections can be successful, as documented by the decline in infections among NNIS hospitals over the past decade.
- Multidisciplinary activities were used by the hospitals with successful programs, but common themes include the traditional components of successful patient safety interventions: measurement, benchmarking, intervention teams, feedback, and monitoring of on-going progress toward improvement.
- Successful programs placed a strong emphasis on infection control practices and appropriate nurse:patient staffing ratios to provide the required expertise for success.



## **Prevent Transmission**

### **Step 11: Isolate the pathogen**

**Fact:** Patient-to-patient spread of pathogens can be prevented.

#### **Actions:**

- ✓ use standard infection control precautions
- ✓ contain infectious body fluids  
(use approved airborne/droplet/contact isolation precautions)
- ✓ when in doubt, consult infection control experts

➤ Link to: [A VRE prevention success story](#)

➤ Link to: [CDC isolation guidelines and recommendations](#)



•Adherence to common-sense measures to isolate antimicrobial-resistant organisms before they are transferred to other patients or become endemic in a facility is essential.

•When in doubt about appropriate isolation procedures, consultation with an infection control professional is indicated.



## *Prevent Transmission* **Step 12: Break the chain of contagion**

**Fact:** Healthcare personnel can spread antimicrobial-resistant pathogens from patient-to-patient.



- Healthcare personnel are important components of the chain of transmission in hospitals.
- Antimicrobial-resistant pathogens from one patient are transmitted to another when lapses in proper hand hygiene and other infection control practices occur.
- Healthcare personnel can also transmit their own flora and infectious pathogens to patients.



## Airborne/Droplet Transmission of Pathogens from Healthcare Personnel to Patients

Pathogen	Circumstance
Influenza virus	lack of vaccination
Varicella-zoster virus	disseminated infection
<i>Mycobacterium tuberculosis</i>	cavitary disease
<i>Bordetella pertussis</i>	undiagnosed prolonged cough
<i>Streptococcus pyogenes</i>	asymptomatic carriage; perioperative transmission
<i>Staphylococcus aureus</i>	viral URI ("cloud" healthcare provider)

Source: Sherertz RJ et al: *Emerg Infect Dis* 2001; 7:241-244



➤ Link to: ["Cloud" healthcare personnel](#)

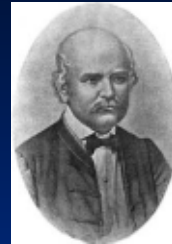
- Healthcare personnel can serve as sources of airborne pathogens including tuberculosis, varicella, and influenza infections in hospitals. Circumstances for transmission are exemplified below.
- Undiagnosed healthcare personnel with pertussis often have prolonged cough that promotes spread to patients.
- Asymptomatic colonization with Group A *Streptococcus pyogenes* has been implicated in outbreaks of streptococcal infection among surgical and obstetrical patients.
- Viral upper respiratory tract infection promotes dispersal of *Staphylococcus aureus* from colonized healthcare personnel and is a documented source of airborne transmission to patients.
- Viral infections may induce the so-called "cloud" healthcare provider phenomenon and promote transmission of a variety of pathogens, including MRSA, that colonize the oropharyngeal and nasal mucosa.



## Improved Patient Outcomes associated with Proper Hand Hygiene



Chlorinated lime hand antisepsis



Ignaz Philipp Semmelweis  
(1818-65)



➤ [Link to: Ignaz Semmelweis](#)

- Ignaz Philipp Semmelweis (1818-65), a Hungarian obstetrician, introduced antiseptic hand hygiene techniques.
- Semmelweis noted that post-partum women examined by medical students who did not wash their hands after performing autopsies had high mortality rates.
- He required students to clean their hands with chlorinated lime before examining patients
- Maternal mortality declined from 12% to less than 1% after this hand hygiene intervention was implemented.



## Effect of Hand Hygiene on Resistant Organisms

Year	Author	Setting	Impact on organisms
1982	Maki	adult ICU	decreased
1984	Massanari	adult ICU	decreased
1990	Simmons	adult ICU	no effect
1992	Doebbeling	adult ICU	decreased with one versus another hand hygiene product
1994	Webster	NICU	MRSA eliminated
1999	Pittet	hospital	MRSA decreased

ICU = intensive care unit; NICU = neonatal ICU

MRSA = methicillin-resistant *Staphylococcus aureus*

Source: Pittet D. *Emerg Infect Dis* 2001;7:234-240

➤ Link to: [Improving hand hygiene](#)



- Hand hygiene is a simple and effective measure for preventing hospital-onset infections
- Average adherence varies among hospital wards, among professional categories of healthcare personnel, and according to working conditions, but is usually < 50%
- Improving hand hygiene can prevent transmission of antimicrobial-resistant pathogens and decrease infection rates in hospitals.

Detail of Slide Table including references:

Year	Author	Setting	Results	Reference
1977	Casewell	Adult ICU	Decreased <i>Klebsiella spp.</i> Infection	1
1982	Maki	Adult ICU	Decreased infection rates	2
1984	Massanari	Adult ICU	Decreased infection rates	3
1990	Simmons	Adult ICU	No effect	4
1992	Doebbeling	Adult ICU	Decreased infection with one versus another hand hygiene agent	5
1994	Webster	NICU	MRSA elimination	6
1995	Zafar	Nursery	MRSA elimination	7
1999	Pittet	Hospital	Decreased infection & MRSA rates	8

ICU = intensive care unit; NICU = neonatal ICU

MRSA = methicillin-resistant *Staphylococcus aureus*

1. Casewell M, Phillips I. Hands as route of transmission for *Klebsiella* species. *BMJ* 1977;2:1315-7.
2. Maki D, Hecht J. Antiseptic containing hand-washing agents reduce nosocomial infections: a prospective study [Abstract #188]. Program and abstracts of the 22nd Interscience Conference of Antimicrobial Agents and Chemotherapy, Miami, Oct 4-6, 1982. Washington, DC: American Society for Microbiology; 1982.
3. Massanari RM, Heirholzer WJJ. A crossover comparison of antiseptic soaps on nosocomial infection rates in intensive care units. *Am J Infect Control* 1984;12:247-8.
4. Simmons B, Bryant J, Neiman K, Spencer L, Arheart K. The role of handwashing in prevention of endemic intensive care unit infections. *Infect Control Hosp Epidemiol* 1990;11:589-94.
5. Doebbeling BN, Stanley GL, Sheetz CT, Pfaller MA, Houston AK, Annis L, et al. Comparative efficacy of alternative hand-washing agents in reducing nosocomial infections in intensive care units. *N Engl J Med* 1992;327:88-93.
6. Webster J, Faoagali JL, Cartwright D. Elimination of methicillin-resistant *Staphylococcus aureus* from a neonatal intensive care unit after hand washing with triclosan. *J Paediatr Child Health* 1994;30:59-64.
7. Zafar AB, Butler RC, Reese DJ, Gaydos LA, Mennonna PA. Use of 0.3% triclosan (Bacti-Stat\*) to eradicate an outbreak of methicillin-resistant *Staphylococcus aureus* in a neonatal nursery. *Am J Infect Control* 1995;23:200-8.
8. Pittet D, Hugonnet S, Harbarth S, Mourouga P, Sauvan V, Touveneau S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet* 2000;356:1307-12.



## **Prevent Transmission**

### **Step 12: Break the chain of contagion**

**Fact:** Healthcare personnel can spread antimicrobial-resistant pathogens from patient to patient.

#### **Actions:**

- ✓ stay home when you are sick
- ✓ contain your contagion
- ✓ keep your hands clean
- ✓ set an example!

- [\*Link to: Health guidelines for healthcare personnel\*](#)
- [\*Coming soon...new guidelines for hand hygiene\*](#)



- Simple common-sense measures can prevent spread of pathogens from healthcare providers to their patients
- These measures include:
  - staying home when ill with an infection that could be transmitted to patients and co-workers in the hospital
  - covering your mouth when coughing or sneezing
  - maintaining appropriate hand hygiene before and after patient contact
- Setting an example for students, trainees, and colleagues



# 12 Steps to Prevent Antimicrobial Resistance: Hospitalized Adults

*Clinicians hold the solution...  
Take steps NOW to prevent antimicrobial resistance!*

- |    |                                    |                              |
|----|------------------------------------|------------------------------|
| 12 | Break the chain                    | Prevent Transmission         |
| 11 | Isolate the pathogen               |                              |
| 10 | Stop treatment when cured          | Use Antimicrobials Wisely    |
| 9  | Know when to say "no" to vanco     |                              |
| 8  | Treat infection, not colonization  |                              |
| 7  | Treat infection, not contamination |                              |
| 6  | Use local data                     | Diagnose & Treat Effectively |
| 5  | Practice antimicrobial control     |                              |
| 4  | Access the experts                 |                              |
| 3  | Target the pathogen                | Prevent Infections           |
| 2  | Get the catheters out              |                              |
| 1  | Vaccinate                          |                              |



- Clinicians hold the solution to antimicrobial resistance...
- The “12 Steps to Prevent Antimicrobial Resistance: Hospitalized Adults” is one of the new tools to encourage clinicians to engage in actions that will promote patient safety and prevent antimicrobial-resistant infections.
- The evidence-based action steps are designed to optimize the care of individual patients in the era of widespread antimicrobial resistance.
- Additional “12 Steps to Prevent Antimicrobial Resistance” will address other target patient populations, including children, geriatric patients, dialysis patients, surgical patients, etc. will be available soon!



## Campaign to Prevent Antimicrobial Resistance

Funded by the CDC Foundation with support from Pharmacia, Inc., Premier, Inc., the Sally S. Potter Endowment Fund for the Prevention of Antimicrobial Resistance, Ortho-McNeil Pharmaceutical, Inc., and Pfizer Inc..


Endorsed by the American Society for Microbiology, Infectious Diseases Society of America, National Foundation for Infectious Diseases, and the American College of Physicians- American Society of Internal Medicine.

*Clinicians hold the solution!*

➤ [Link to: CDC Foundation](#)



CDC thanks the CDC Foundation for its support for the Campaign to Prevent Antimicrobial Resistance. In conjunction with the Foundation, corporate partners, professional societies, healthcare organizations, public health agencies, and expert consultants are working together to combat this threat to patient safety.





Campaign to Prevent Antimicrobial Resistance in Healthcare Settings

# Prevention IS PRIMARY!

*Protect patients...protect healthcare personnel...  
promote quality healthcare!*

Division of Healthcare Quality Promotion  
National Center for Infections Diseases



➤ [Link to: Division of Healthcare Quality Promotion Home Page](#)

- Prevention is Primary!